Apprenticeship and Industry Training

Welder

Apprenticeship Course Outline

1214 (2014)

Alberta

Apprenticeship and Industry Training

ALBERTA INNOVATION AND ADVANCED EDUCATION

Welder : apprenticeship course outline

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Welder
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Course Outline

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Welder Provincial Apprenticeship Committee.

The graduate of the Welder apprenticeship program is a certified journeyperson who will be able to:

- be skilful in the fusing of metals using prescribed welding applications
- have a working knowledge of the welding equipment involved with the various welding procedures
- comprehend drawings and develop layout patterns for projects and calculate quantities of materials
- have a thorough knowledge of metals, arc electrodes, welding gases and gas welding filler rods
- recognize defective welds; know the cause and proper procedure for the repair of the defective area
- have a working knowledge of mathematics calculations pertaining to the welding trade
- have a working knowledge of the required codes
- be familiar with the work of other trades people in affiliated trades
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Welder PAC Members at the Time of Publication

Mr. L Burns	Okotoks	Presiding Officer
Mr. R. Cunningham	Calgary	Employer
Mr. R. Davis	Calgary	Employer
Mr. W. Greenslade	Hanna	Employer
Mr. J. MacPherson	Calgary	Employer
Mr. S. Olson	Coalhurst	Employer
Mr. T. Stewart	Edmonton	Employer
Mr. T. Wonitowy	Edmonton	Employer
Mr. A. Belter	Edmonton	Employer
Mr. C. Dahl	Leduc	Employee
Mr. M. Hamm	Red Deer	Employee
Mr. D. Hennig	Stony Plain	Employee
Mr. J. Norris	Edmonton	Employee
Mr. L. Wyatt	Ft. McMurray	Employee

Alberta Government

Alberta Advanced Education works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

> **The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act*.**

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.alberta.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Occupational Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Occupational Health and Safety (a division of Alberta Human Services) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.humanservices.alberta.ca

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Welder apprenticeship technical training:

Medicine Hat College
Keyano College
Northern Alberta Institute of Technology
Southern Alberta Institute of Technology
Grande Prairie Regional College
Olds College
Lakeland College
Red Deer College
Lethbridge College
Northern Lakes College (Slave Lake)
Portage College (Lac La Biche)

Procedures for Recommending Revisions to the Course Outline

Advanced Education has prepared this course outline in partnership with the Welder Provincial Apprenticeship Committee.

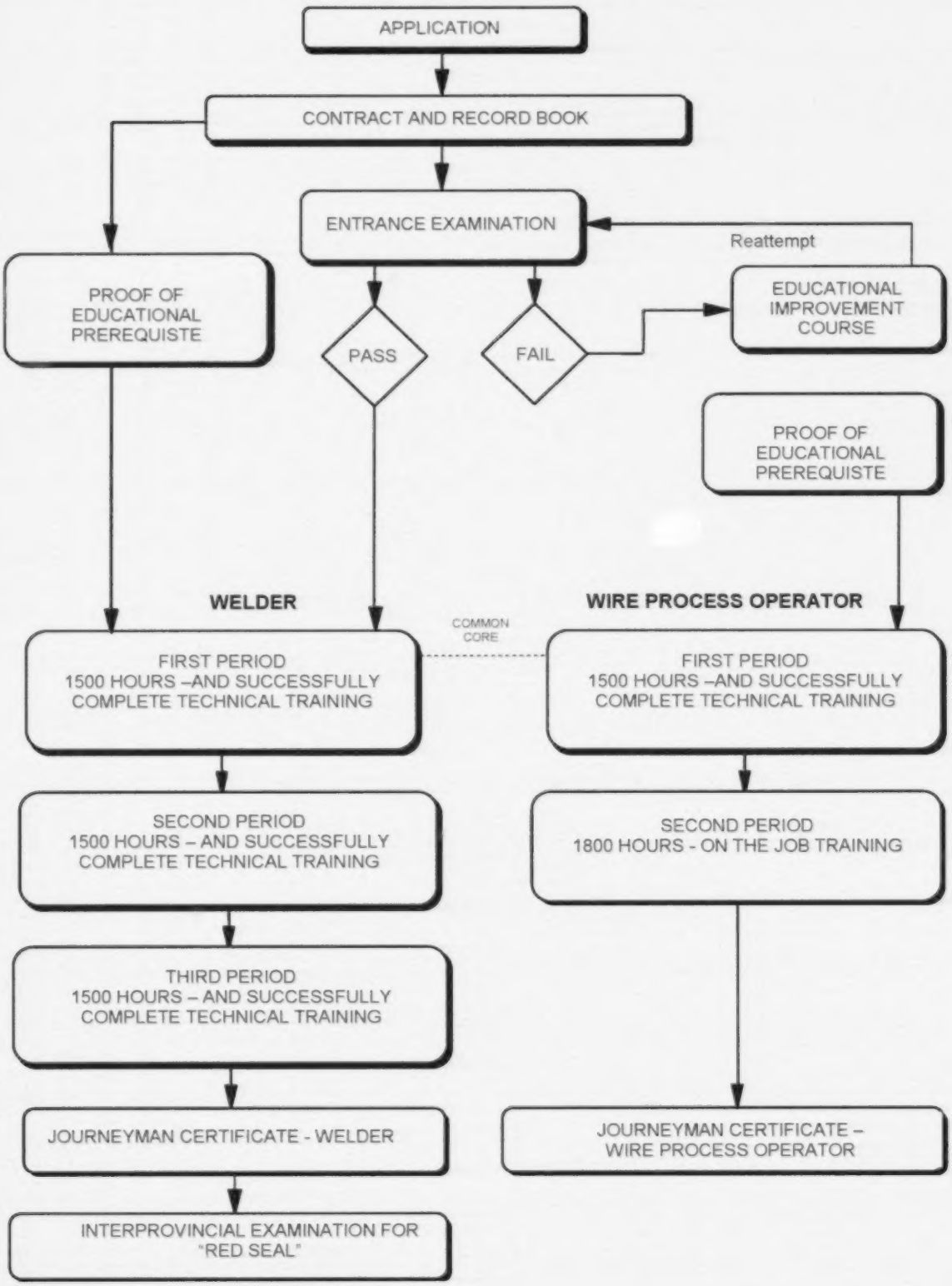
This course outline was approved on December 13, 2013 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Welder Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Welder Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification


APPLICATION
CONTRACT AND RECORD BOOK
ENTRANCE EXAMINATION
Reattempt
PROOF OF EDUCATIONAL PREREQUISTE
PASS
FAIL
EDUCATIONAL IMPROVEMENT COURSE
PROOF OF EDUCATIONAL PREREQUISTE
WELDER
COMMON CORE
WIRE PROCESS OPERATOR
FIRST PERIOD 1500 HOURS –AND SUCCESSFULLY COMPLETE TECHNICAL TRAINING
FIRST PERIOD 1500 HOURS –AND SUCCESSFULLY COMPLETE TECHNICAL TRAINING
SECOND PERIOD 1500 HOURS – AND SUCCESSFULLY COMPLETE TECHNICAL TRAINING
SECOND PERIOD 1800 HOURS - ON THE JOB TRAINING
THIRD PERIOD 1500 HOURS – AND SUCCESSFULLY COMPLETE TECHNICAL TRAINING
JOURNEYMAN CERTIFICATE - WELDER
JOURNEYMAN CERTIFICATE – WIRE PROCESS OPERATOR
INTERPROVINCIAL EXAMINATION FOR "RED SEAL"

Welder Training Profile
FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

WORKPLACE SAFETY AND TOOLS

46 HOURS

A	B	C
Safety Legislation, Regulations and Industry Policy in the Trades 4 Hours	Climbing, Lifting, Rigging and Hoisting 3 Hours	Hazardous Materials and Fire Protection 3 Hours
D	**E**	**F**
Alberta's Industry Network 1 Hour	Welding Safety 4 Hours	Hand Tools 2 Hours
G	**H**	**I**
Power Tools 4 Hours	Oxyfuel Equipment 6 Hours	Oxyfuel Cutting 8 Hours
J	**K**	
Plasma Arc Cutting and Gouging 3 Hours	Materials Handling 8 Hours	

SECTION TWO

WELDING TECHNOLOGY AND PROPERTIES OF METALS

48 HOURS

A	B	C
Drawing Interpretation 8 Hours	Electricity 12 Hours	Metal Identification 2 Hours
D	**E**	**F**
Heat Treatment 2 Hours	Joint and Weld Types 3 Hours	Welding Symbols 4 Hours
G	**H**	**I**
Distortion 7 Hours	Weld Faults 7 Hours	Hardfacing 3 Hours

SECTION THREE

GMAW, FCAW, MCAW and SAW

117 HOURS

A	B	C
Wire Feed Welding Equipment Power Sources 6 Hours	Wire Feed Welding Filler Metals and Feeders 6 Hours	Wire Feed Welding Shielding Gases 6 Hours
D	**E**	**F**
Wire Welding Maintenance and Troubleshooting 6 Hours	GMAW on Mild Steel 26 Hours	FCAW and MCAW on Mild Steel 20 Hours
G	**H**	**I**
GMAW, FCAW and MCAW Groove Welds on Mild Steel 12 Hours	Aluminum and Aluminum Welding 6 Hours	GMAW on Aluminum 3 Hours
J	**K**	
GMAW, FCAW and MCAW on Mild Steel Pipe 24 Hours	Submerged Arc Welding (SAW) 2 Hours	

SECTION FOUR

TRADE MATH

29 HOURS

A

Fractions

4 Hours

B

Decimals

4 Hours

C

Percentage and Ratios

6 Hours

D

Geometric Formulas

8 Hours

E

Metric and Imperial Measure

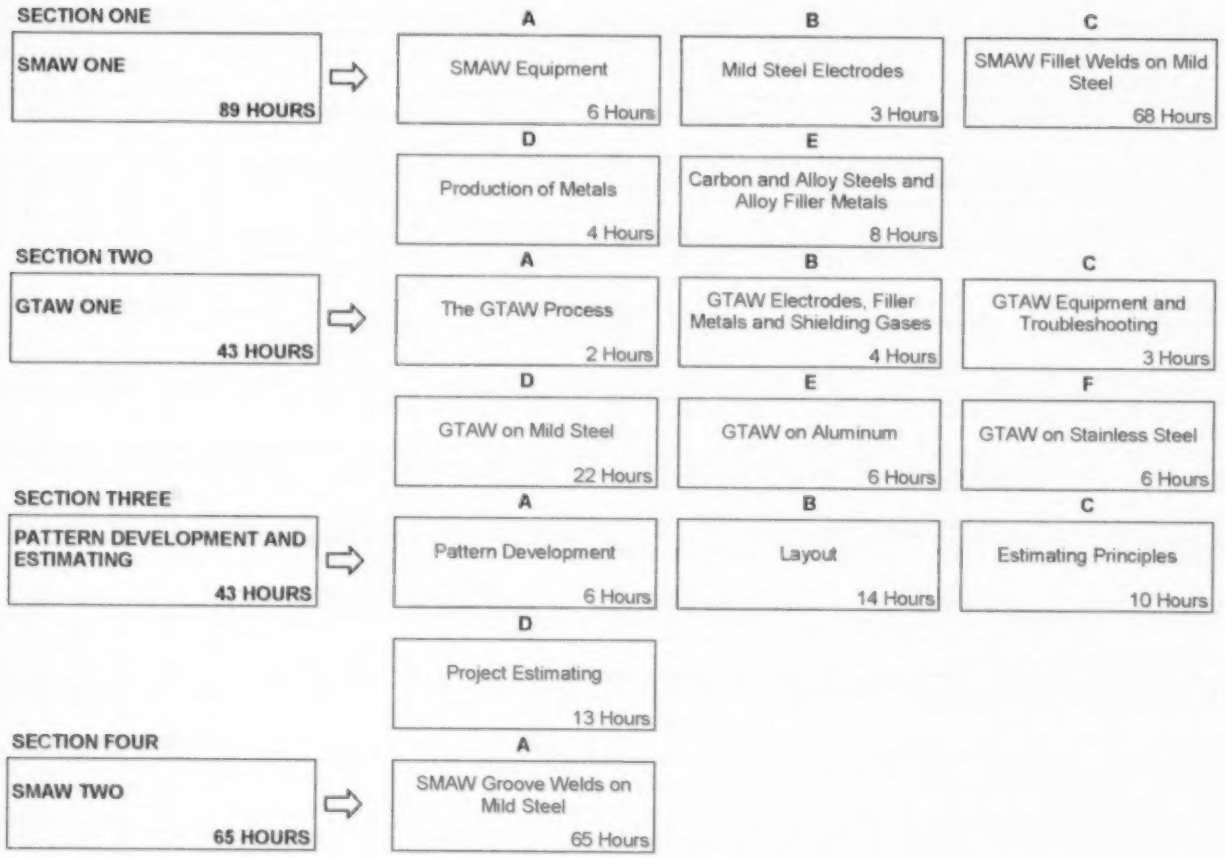
6 Hours

F

Welder/Wire Process Operator Apprenticeship Training Program Orientation

1 Hour

SECOND PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)



THIRD PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

		A	B	C
SECTION ONE				
SMAW THREE **72 HOURS**	⇨	Stainless Steel 6 Hours	Nickel Alloys and Clad Steels 6 Hours	SMAW and Oxyfuel Cutting on Mild Steel 60 Hours
SECTION TWO		A	B	
WELDS ON MILD STEEL PLATE AND PIPE **104 HOURS**	⇨	SMAW on Mild Steel Pipe 52 Hours	GTAW on Mild Steel Plate and Pipe 52 Hours	
SECTION THREE		A	B	C
DRAWING INTERPRETATION **40 HOURS**	⇨	Structural Drawings 12 Hours	Pressure Vessel Drawings 16 Hours	Pipe Drawings 12 Hours
SECTION FOUR		A	B	C
TRADE SCIENCE **24 HOURS**	⇨	Non-Destructive Testing 4 Hours	Destructive Testing 4 Hours	Metallurgy for Practical Applications 3 Hours
		D	E	F
		Codes and Standards 10 Hours	Workplace Coaching Skills 1 Hour	Interprovincial Standards Red Seal Program 2 Hours

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
WELDER AND WIRE PROCESS OPERATOR TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... WORKPLACE SAFETY AND TOOLS ..... 46 HOURS

A. Safety Legislation, Regulations and Policy in the Trades ..... 4 Hours

Outcome: ***Describe legislation, regulations and practices intended to ensure a safe work place in this trade.***

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OHS) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting ..... 3 Hours

Outcome: ***Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.***

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials and Fire Protection ..... 3 Hours

Outcome: ***Describe the safety practices for hazardous materials and fire protection in this trade.***

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

D. Alberta's Industry Network ..... 1 Hour

Outcome: ***Describe the role of the Alberta Apprenticeship and Industry Training Board and the network of industry committees that represent the trades and occupations in Alberta.***

1. Describe Alberta's apprenticeship and industry training system.
2. Describe the roles and responsibilities of the Alberta Apprenticeship and Industry Training Board, government and post-secondary institutions.
3. Describe the roles and responsibilities of the PAC'S, LAC'S and occupational committees.

E. Welding Safety ..... 4 Hours

Outcome: ***Apply safe work practices according to Occupational Health and Safety Act (OHS) legislation.***

1. Identify hazards for welding and cutting operations.
2. Identify the use of personal protective equipment for welding and cutting operations.
3. Explain the hazards involved with welding fumes and gases.
4. Identify welding fume ventilation methods.
5. Explain the effects of electricity and precautions used to prevent injury.
6. Describe the procedure for welding or cutting in confined spaces or potentially dangerous enclosures.
7. Interpret sections of the *Occupational Health and Safety Act*, general safety regulations.

F. Hand Tools ..... 2 Hours

Outcome: ***Use hand tools.***

1. Describe safety precautions for hand tools.
2. Identify the layout and measuring tools and their uses.
3. Identify clamping tools and their uses.
4. Identify cutting tools and their uses.
5. Identify the other hand tools used by welders.

G. Power Tools ..... 4 Hours

Outcome: ***Use power tools.***

1. Demonstrate the operation of bench, pedestal, angle and straight grinders.
2. Demonstrate the operation of portable power drills, drill presses and twist drills.
3. Describe the operation of metal forming and shaping tools.
4. Describe the operation for metal cutting tools.
5. Describe the use of power positioners.

H. Oxyfuel Equipment ..... 6 Hours

Outcome: ***Assemble oxyfuel equipment.***

1. Describe the characteristics and handling procedures for oxygen and fuel gases.
2. Describe the functions of oxyfuel equipment components.
3. Demonstrate the use, care and maintenance of oxyfuel equipment components.

4. Explain the procedure for placement, set-up and shutting down of oxyfuel equipment.
5. Identify causes and preventive measures for backfires, flashbacks and burn backs.
6. Describe pressure and flame adjustments.

I. Oxyfuel Cutting ..... 8 Hours

Outcome: Perform oxyfuel cutting.

1. Describe how to operate a hand-held oxyfuel cutting torch on mild steel plate and structural shapes.
2. Perform straight line, bevel, and shape cutting on mild steel.
3. Pierce and cut holes in mild steel plate.
4. Cope 3/8" mild steel to fit a 100 mm (4") C shape.
5. Perform cuts on structural shapes.
6. Operate a machine oxyfuel cutting torch on mild steel plate and pipe.

J. Plasma Arc Cutting and Gouging ..... 3 Hours

Outcome: Cut and gouge using the plasma arc and carbon arc cutting processes.

1. Describe the plasma arc cutting process and equipment.
2. Observe plasma arc cutting.
3. Describe the carbon arc cutting process.
4. Gouge using the carbon arc cutting process.

K. Materials Handling ..... 8 Hours

Outcome: Apply materials handling procedures.

1. Identify procedures for handling and storing materials.
2. Determine weight and centre of gravity of loads.
3. Identify the load limits of wire rope and synthetic slings.
4. Describe the use of plate clamps and cable clips.

SECTION TWO: .....WELDING TECHNOLOGY AND PROPERTIES OF METALS..... 48 HOURS

A. Drawing Interpretation ..... 8 Hours

Outcome: Read and interpret drawings.

1. Identify the alphabet of lines.
2. Explain the purpose of drawings.
3. Identify elements and information found on drawings.
4. Interpret symbols, views and sections used on drawings.
5. Identify SI metric and imperial dimensioning.

B. Electricity ..... 12 Hours

Outcome: Describe electrical concepts.

1. Define electrical terms.
2. Describe electron flow.

3. Describe single-phase and three-phase power.
4. Describe AC and AC-DC rectified power sources.
5. Describe AC and DC generator power sources.
6. Describe multi-process inverter power sources.
7. Describe welding power source installation and maintenance.

C. Metal Identification ..... 2 Hours

Outcome: Identify types of metals and their characteristics.

1. Identify metals by visual appearance, colour, relative weight, typical shape and texture.
2. Describe chip, spark, file hardness and flame tests.
3. Interpret information supplied on mill test reports.
4. Describe the mechanical properties of metals.
5. Describe the physical properties of metals.

D. Heat Treatment ..... 2 Hours

Outcome: Identify the effects of heat treatment on carbon steels.

1. Define heat-affected zones in metals.
2. Explain the difference between heat and temperature.
3. Explain the three forms of heat transfer.
4. Describe the effects of expansion and contraction.
5. Describe the purpose and effects of preheat and postheat.
6. Describe the practices of heat treatment.
7. Explain the principle of temperature-indicating devices.

E. Joint and Weld Types ..... 3 Hours

Outcome: Identify joints and weld types.

1. Identify the five basic joints.
2. Describe the types of welds and their dimensions.
3. Identify joint and weld type variations.
4. Outline the considerations in the design of a joint for welding.

F. Welding Symbols ..... 4 Hours

Outcome: Interpret welding symbols.

1. Explain the purpose of welding symbols.
2. Define weld symbol, welding symbol and supplementary symbols.
3. Interpret weld symbols and welding symbols.
4. Identify the dimensioning of welding symbols.
5. Interpret non-destructive testing symbols.

G. Distortion ..... 7 Hours

Outcome: Identify distortion and methods of control.

1. Identify how heat and temperature relate to distortion.
2. Identify the three types of distortion, their causes and control of each type.
3. Describe the mechanical, procedural and design methods of controlling distortion.

H. Weld Faults ..... 7 Hours

Outcome: Identify weld faults.

1. Define the classifications of weld faults.
2. Define the notching effect.
3. Identify weld faults, their causes and methods of prevention.

I. Hardfacing ..... 3 Hours

Outcome: Observe hardfacing of steel.

1. Describe the hardfacing process and applications.
2. Identify the types of wear.
3. Identify filler metals for hardfacing.
4. Identify the problems associated with hardfacing and how to avoid them.
5. Describe the procedures for applying hardfacing materials with filler wires.

SECTION THREE: ..... GMAW, FCAW, MCAW and SAW ..... 117 HOURS

A. Wire Feed Welding Equipment Power Sources ..... 6 Hours

Outcome: Select wire feed welding equipment.

1. Describe the principles of operation of wire feed welding equipment.
2. Identify the components of a wire feed welding equipment set-up.
3. Describe wire process welding equipment power sources and wire feeders.
4. Identify advantages and disadvantages of wire feed processes.

B. Wire Feed Welding Filler Metals and Feeders ..... 6 Hours

Outcome: Select wire feed welding consumables.

1. Identify wire feed welding equipment filler metals.
2. Describe the modes of metal transfer.
3. Describe wire feed drive systems and gun and cable accessories.
4. Describe wire feed operating variables.

C. Wire Feed Welding Shielding Gases ..... 6 Hours

Outcome: Select shielding gases for the wire feed process.

1. Identify shielding gases for wire feed processes.
2. Identify shielding gas supply systems.

D. Wire Welding Maintenance and Troubleshooting ..... 6 Hours

Outcome: Set up, maintain and troubleshoot wire welding equipment.

1. Demonstrate the set-up and maintenance required for wire drive systems and gun assemblies.
2. Perform corrective measures for malfunctioning wire process equipment.

E. GMAW on Mild Steel ..... 26 Hours

Outcome: Perform fillet and groove welds on mild steel.

1. Weld stringer and weave beads in the flat and horizontal positions.
2. Weld in the 1F, 2F and 3F positions.
3. Weld in the 1G, 2G, 3G and 4G positions.
4. Weld a 1GR.
5. Use CWB test procedures.
6. Weld the 1GF, 2G, 3GF and 4GF joint configurations with a 1/4" backing plate.
7. Weld on structural shapes.

F. FCAW and MCAW on Mild Steel ..... 20 Hours

Outcome: Perform FCAW and MCAW operations in multiple positions.

1. Weld stringer and weave beads in the flat and horizontal positions on mild steel plate.
2. Weld in the 1F, 2F and 3F positions using the FCAW process.
3. Weld using the MCAW process.
4. Use CWB testing procedures.
5. Weld in the 1GF, 2G, 3GF and 4GF joint configurations using the FCAW process with a 1/4" backing plate.
6. Weld on structural shapes.

G. GMAW, FCAW and MCAW Groove Welds on Mild Steel ..... 12 Hours

Outcome: Perform GMAW, FCAW and MCAW welds on mild steel.

1. Weld butt joints in the 1G, 2G and 3G positions on mild steel using GMAW for the root bead and FCAW or MCAW fill and cap.
2. Weld with MCAW on various joint configurations.

H. Aluminum and Aluminum Welding ..... 6 Hours

Outcome: Explain aluminum properties and principles.

1. Explain the physical and chemical properties of aluminum and steel.
2. Explain how physical and chemical properties affect the welding of aluminum.
3. Explain the Aluminum Association numerical designation for casting alloys and wrought aluminum.
4. Explain the effects of welding on heat treatable and non-heat treatable alloys.
5. Weld aluminum and its alloys.
6. List the filler metals used for welding aluminum with GMAW.

I. GMAW on Aluminum ..... 3 Hours

Outcome: Perform welds on aluminum.

1. Weld stringer/weave beads in the flat and horizontal positions on 3.2 mm (1/8") or greater aluminum material.
2. Weld in the 1F, 2F, and 3F on 3.2 mm (1/8") or greater aluminum material.

J. GMAW, FCAW and MCAW on Mild Steel Pipe ..... 24 Hours

Outcome: Perform GMAW, FCAW and MCAW on mild steel pipe.

1. Weld in the 2G position on pipe using GMAW.
2. Weld in the 1G-rotated position on pipe using a GMAW root pass and FCAW or MCAW fill and cap.
3. Weld in the 2G position on pipe using GMAW root pass and FCAW fill and cap.
4. Weld with GMAW in the 5G position on pipe root pass downhill, fill and cap uphill.

K. Submerged Arc Welding (SAW) ..... 2 Hours

Outcome: Describe the components and operation of the SAW process.

1. Describe the principles of operation of SAW.
2. Identify the components of a SAW set-up.
3. Describe SAW power sources, wire feeders, flux feed systems, welding head assemblies and control systems.
4. Describe SAW operating variables.
5. Identify SAW filler metals and fluxes.
6. Describe SAW equipment maintenance and troubleshooting.
7. Identify advantages and disadvantages of SAW.

SECTION FOUR: ..... TRADE MATH ..... 29 HOURS

A. Fractions ..... 4 Hours

Outcome: Solve problems involving fractions.

1. Identify terms and concepts used with fractions.
2. Use practical fractions with a tape measure.
3. Change fractions to a common denominator.
4. Solve problems using whole numbers and fractions in practical applications.

B. Decimals ..... 4 Hours

Outcome: Solve problems involving decimals.

1. Round decimal fractions to specified place values.
2. Add, subtract, multiply and divide decimal fractions.
3. Convert fractions to decimals.
4. Convert decimal inches and decimal feet, to feet and inch fractions with a practical denominator.
5. Solve decimal fraction calculations.

C. Percentage and Ratios ..... 6 Hours

Outcome: Solve problems involving percentage and ratios.

1. Calculate ratio problems: two quantities in the form of a ratio and two ratios in the form of a proportion.
2. Convert between fractions, decimals and percent.
3. Solve percent problems.

D. Geometric Formulas ..... 8 Hours

Outcome: Solve problems involving geometric formulas.

1. Identify terms and concepts used in working with formulas.
2. Identify formulas and solve problems for perimeter, area and volume.
3. Calculate the weight of a solid.
4. Calculate the capacity of a container in gallons and liters.

E. Metric and Imperial Measure ..... 6 Hours

Outcome: Solve problems involving metric and imperial measure.

1. Identify metric units of measure.
2. Convert between units of measure.
3. Convert imperial units: feet to inches, square inches to square feet, and cubic measures to gallons.

F. Welder/Wire Process Operator Apprenticeship Training Program Orientation ..... 1 Hour

Outcome: Describe the apprenticeship training system in Alberta.

1. Explain the Welder/Wire Process Operator course outline, learning outcomes and objectives.
2. Describe the responsibilities for the contract of apprenticeship and record book by the apprentice, employer and Alberta Apprenticeship and Industry Training.
3. Identify industrial, commercial and construction fields that provide employment opportunities for welders.
4. Define the role of external organizations that affect the welding trade.

SECOND PERIOD TECHNICAL TRAINING
WELDER TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... SMAW ONE ..... 89 HOURS

A. SMAW Equipment ..... 6 Hours

Outcome: Identify SMAW equipment.

1. Define SMAW related terms.
2. Identify welding cables and accessories for welding power sources.
3. Identify the effect of arc length on amperage and voltage.

B. Mild Steel Electrodes ..... 3 Hours

Outcome: Select mild steel electrodes for SMAW.

1. Define the terms associated with SMAW electrodes.
2. Identify the CSA and AWS classification and specifications for SMAW electrodes.
3. Identify the types and functions of SMAW electrode coatings.
4. Describe the functions of the slag.
5. Describe care, handling and storage procedures for these electrodes.
6. Identify mild steel SMAW electrodes and their applications.

C. SMAW Fillet Welds on Mild Steel ..... 68 Hours

Outcome: Perform SMAW fillet welds on mild steel.

1. Weld surface welds (stringer beads) in the flat position using E4310, E4914 and E4918 electrodes.
2. Weld fillet welds in the 1F 2F, 3F and 4F positions using E4310, E4914 and E4918 electrodes.

D. Production of Metals ..... 4 Hours

Outcome: Identify production processes and types of iron and steel.

1. Describe the production processes for iron and steel.
2. Describe the types of iron and steel.

E. Carbon and Alloy Steels and Alloy Steel Filler Metals ..... 8 Hours

Outcome: Identify carbon steels, alloy steels and alloy steel filler metals.

1. List the carbon content and the uses for low carbon steel, medium carbon steel and high carbon steel.
2. Identify the effect of carbon content on the weldability of steel.
3. Identify the effects of elements in the properties of carbon steel.
4. Identify the major alloying elements in alloy steels.
5. Identify the types, properties and weldability of low alloy steels.

6. Identify the properties and weldability of high strength, low alloy steels (HSLA).
7. Identify alloy steel filler material classifications in the accordance with AWS and CSA specifications.
8. Identify low alloy steel filler metals and their applications.

SECTION TWO: ..... GTAW ONE ..... 43 HOURS

A. The GTAW Process ..... 2 Hours

Outcome: Apply safe work practices and procedures when using GTAW.

1. Describe the GTAW process and applications.
2. Describe advantages and disadvantages of the GTAW process.
3. Explain the hazards and protective measures associated with GTAW.
4. Identify the components of a GTAW workstation.
5. Describe types of GTAW power sources.
6. Identify ac, dc and high frequency welding currents used in GTAW.
7. Describe the torch assembly.
8. Describe gas regulators and flow meters.

B. GTAW Electrodes, Filler Metals and Shielding Gases ..... 4 Hours

Outcome: Select GTAW electrodes, filler metals and gases.

1. Identify the function of the electrode in GTAW.
2. Identify electrodes by AWS designations and explain their applications.
3. Explain the care and preparation of electrodes and filler metals.
4. Identify the function of the filler metals in GTAW.
5. Identify filler metals by AWS and CSA designations and explain their applications.
6. Identify types and purpose of consumable inserts.
7. Describe the types and applications of shielding gases used in GTAW.
8. Describe the advantages and disadvantages of various shielding gases.

C. GTAW Equipment Maintenance and Troubleshooting ..... 3 Hours

Outcome: Troubleshoot and maintain GTAW equipment.

1. Diagnose power source output current problems and demonstrate corrective measures.
2. Diagnose GTAW torch and cable assembly problems and demonstrate corrective measures.
3. Explain the care and handling of GTAW equipment components.
4. Diagnose shielding gas coverage problems and demonstrate corrective measures.

D. GTAW on Mild Steel ..... 22 Hours

Outcome: Perform GTAW on mild steel.

1. Strike an arc using the touch start, lift start and high frequency methods.
2. Weld stringer beads in the flat position on mild steel gauge plate.
3. Prepare joints for GTAW on mild steel gauge plate.

4. Weld fillet welds in the 1F 2F and 3F positions on mild steel gauge plate.
5. Weld 1G, 2G, 3G on 1/4" or 3/8" plate and on pipe in the 2G and 5G.

E. GTAW on Aluminum ..... 6 Hours

Outcome: Perform GTAW on aluminum.

1. Weld stringer beads in the flat position on aluminum gauge plate.
2. Weld in the 1F, 2F and 3F positions on aluminum gauge plate.

F. GTAW on Stainless Steel ..... 6 Hours

Outcome: Perform GTAW on stainless steel.

1. Select filler metals used on stainless steel.
2. Select the welding procedure and welding current for GTAW on stainless steel gauge plate.
3. Weld in the 2F, 3F and 4F positions on stainless steel gauge plate.

SECTION THREE: ..... PATTERN DEVELOPMENT AND ESTIMATING ..... 43 HOURS

A. Pattern Development ..... 6 Hours

Outcome: Identify shapes, drawings and drawing equipment.

1. Describe the principles of scale drawings.
2. Describe the principles of perspective, oblique and isometric drawings.
3. Describe and sketch orthographic projection.
4. Describe dimensioning rules.
5. Develop an orthographic drawing to scale.
6. Describe drawing tools.
7. Describe the parts of geometric shapes and angles.
8. Apply layouts.

B. Layout ..... 14 Hours

Outcome: Describe layout procedures.

1. Describe layout abbreviations and symbols.
2. Describe layout tools and mark-up methods.
3. Describe templates.
4. Describe the procedure for plate utilization.
5. Identify pipe sizes and schedules.
6. Describe pipe layout tools.

C. Estimating Principles ..... 10 Hours

Outcome: Prepare an estimate for a project.

1. Convert angular (degree) measurements to linear dimensions.
2. Calculate the cost of steel.

D. Project Estimating ..... 13 Hours

Outcome: Conduct an estimate for a project.

1. Estimate total costs for a project.
2. Complete an estimating project.

SECTION FOUR: ..... SMAW TWO ..... 65 HOURS

A. SMAW Groove Welds on Mild Steel ..... 65 Hours

Outcome: Perform SMAW groove welds on mild steel.

1. Weld groove welds in the 1G, 2G, 3G using a E4310 root and E4918 fill and cap.
2. Weld groove welds in the 1GF, 2G, 3GF using a E4918 with 1/4" backing plate.
3. Perform a CWB qualification test to W47.1 standards.
4. Describe guided bend tests.

THIRD PERIOD TECHNICAL TRAINING
WELDER TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... SMAW THREE ..... 72 HOURS

A. Stainless Steel ..... 6 Hours

Outcome: Identify stainless steels and welding procedures.

1. Describe stainless steel.
2. List the three major types of stainless steel and their properties.
3. Identify the AISI numbering system of stainless steel.
4. Explain carbide precipitation and ways of overcoming this problem.
5. Identify the major types of stainless steel filler materials and AWS specifications.
6. Describe handling and storage of stainless steel electrodes and filler materials.
7. Explain the handling procedures and preparation for welding stainless steel.

B. Nickel Alloys and Clad Steels ..... 6 Hours

Outcome: Identify nickel alloys and clad steels and their welding procedures.

1. Describe nickel and its alloys.
2. Select filler metals in AWS specifications.
3. Explain welding procedures for nickel alloys.
4. Explain weld faults and how to overcome these when welding nickel alloys.
5. Describe clad steels and list their advantages.
6. Explain preparation and welding procedures for clad steels.

C. SMAW and Oxyfuel Cutting on Mild Steel ..... 60 Hours

Outcome: Perform SMAW and oxyfuel cutting procedures on mild steel.

1. Weld butt joints in the 3G, 45° overhead and 4G positions on 9.6 mm (3/8") mild steel using E4310 for the root pass and E4918 for the fill and cap.
2. Weld butt joints in the 4GF position on 9.6 mm (3/8") mild steel plate using E4918 with backing according to CSA Standard W47.1.
3. Perform oxyfuel bevel cutting on mild steel.
4. Pierce and cut a W shape opening in mild steel plate.

SECTION TWO: ..... WELDS ON MILD STEEL PLATE AND PIPE ..... 104 HOURS

A. SMAW on Mild Steel Pipe ..... 52 Hours

Outcome: Perform SMAW in the 2G-5G and 5G positions.

1. Prepare, fit up and tack weld pipe for SMAW.
2. Feather tack welds.

3. Identify the pipe welding positions.
4. Weld butt joints on 150 mm (6") schedule 80 pipe in the 2G-5G positions using an E4310 root and E4918 fill and cap.
5. Weld butt joints on pipe in the 5G position downhill.
6. Perform the "B" pressure performance qualification test.

B. GTAW on Mild Steel Plate and Pipe ..... 52 Hours

Outcome: Perform GTAW in the 1G, 2G, 3G, 5G and 6G positions on mild steel.

1. Prepare and fit-up for GTAW.
2. Weld in the 1G and 2G positions on 6.4 mm (1/4") mild steel plate.
3. Weld in the 3G position (uphill) on 9.6 mm (3/8") mild steel plate and E4918 for the fill and cap.
4. Weld in the 2G, 5G and 6G positions on mild steel pipe.

SECTION THREE: ..... DRAWING INTERPRETATION ..... 40 HOURS

A. Structural Drawings ..... 12 Hours

Outcome: Interpret structural drawings.

1. Interpret abbreviations used on drawings.
2. Identify site plans, bench marks and orientation.
3. Identify structural shapes and how they are specified.
4. Identify types of structural drawings.
5. Obtain dimensions and other information from drawings.
6. Reference bill of materials for drawings.
7. Interpret drawings.

B. Pressure Vessel Drawings ..... 16 Hours

Outcome: Interpret pressure vessel drawings.

1. Identify external and internal vessel components.
2. Identify material compositions as per code requirement on mill certification.
3. Interpret vessel drawings.

C. Piping Drawings ..... 12 Hours

Outcome: Interpret piping drawings.

1. Explain the purpose of a spool sheet.
2. Interpret symbols that represent individual components on a spool sheet.
3. Interpret position and orientation of piping systems from an isometric drawing.
4. Interpret component sizes in a piping system from a spool sheet.
5. Draw sketches of piping assemblies in schematic form from an isometric drawing.
6. Compile a material list for a simple piping system.
7. Interpret pipe drawings.

SECTION FOUR: ..... TRADE SCIENCE. ..... 24 HOURS

A. Non-Destructive Testing ..... 4 Hours

Outcome: Identify the types and uses of non-destructive testing methods.

1. Identify non-destructive tests.
2. Describe visual inspection techniques.
3. Describe hydrostatic tests.

B. Destructive Testing ..... 4 Hours

Outcome: Identify the types and uses of destructive testing methods.

1. Identify types of destructive tests, nick break, Charpy and Izod impact, tensile and etching.
2. Describe the advantages and disadvantages of destructive testing methods.
3. Describe methods of conducting guided bend tests and the test results required of a sound weld.
4. Describe tensile testing.
5. Describe hardness testing.

C. Metallurgy for Practical Applications ..... 3 Hours

Outcome: Describe the metallurgical properties of steel.

1. Describe dendritic grain growth.
2. Identify space-lattice types in metals.
3. Describe grain structure in metals, pure iron, slowly-cooled carbon steels and rapidly-cooled carbon steels.
4. Identify changes in grain structure that result from welding.

D. Codes and Standards ..... 10 Hours

Outcome: Identify welding codes, standards and specifications.

1. Define the terms code, standard and specification.
2. Identify the advantages of standardization.
3. Identify agencies that set codes and standards.
4. Identify the codes that govern welding in Canada.
5. Describe the welding procedure qualification.
6. Describe the welder performance qualification.

E. Workplace Coaching Skills ..... 1 Hour

Outcome: Display coaching skills.

1. Describe coaching skills used for training apprentices.

F. Interprovincial Standards Red Seal Program ..... 2 Hours

Outcome: Use Red Seal products to challenge an Interprovincial examination.

1. Identify Red Seal products used to develop Interprovincial examinations.
2. Use Red Seal products to prepare for an Interprovincial examination.

Apprenticeship and Industry Training

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